

as one solid rock; on the contrary, it consists of an infinite number of layers, of varying thickness, a rock close & solid as marble, & under it, or above it, a rock of loose, coarse texture. Now, the rain & dew, even hail, atmospheric moisture in whatever form, is laden with carbonic acid, derived from the air itself, or from decaying vegetable matter, and water containing carbonic acid in solution has the property of gradually dissolving the limestone - not merely wearing it away. Now the carbonic acid acts in open to discussion, but the fact remains, it does much to account for the scars, the caves, the potholes, the fantastic rock forms of ~~Western~~ ^{the underground caverns} ~~Yorkshire~~ this district. Add to this the common effect of weathering upon rocks of unequal hardness throughout, & how the water percolates through the softer lower strata, greys, ^{marls} walls, bursts the rock out holds it - as it might burst a pitote, & leaves a fissure exposed to the further action of the atmosphere, which is for ever wearing away, as well as dissolving the yielding limestone.

This is the history of the fine scars, which stand like so many fortresses up & down the Wharfe valley. Drifting water has found its way through the loose points, has eaten the carbonic acid in solution, has eaten out a way through dense layers, debris broken off by the one cause or the other has fallen with base of the cliff, until there it stands, a rounded low pass of limestone, with harder layers standing out like courses of heavy masonry, steep as the walls of a castle, sunny like a castle in effect.

It is not too much to say that these cliffs, or scars of Craven are due entirely to atmospheric denudation, & indeed, they are the most picturesque features the limestone

stone presents, for its tendency is ^{to be} ~~become~~ evenly, -
you get long straight fells, with ^{tops as} level as the
coping of a wall, & steep unbroken sides, when,
as in Buckden Pass, above Kettlewell, you are
shut in between two opposing steep fells,
it is as if you were imprisoned between colossal
walls.

Kilnsey Crag, by Arncliffe in Wharfedale, the
Scars of Giggleswick near Settle, in Ribblesdale
& Malham Cove, & Gordale Scar in northern
Airedale, are very fine examples of limestone scars.
The two last, indeed, present some of the finest
rock scenery in England. ^{Gordale Scar has the appearance of a} Malham Cove ^{formed by the action of water}
presents ~~the impression of a~~ the great section
of a vast amphitheatre, with projecting
cornices which may represent tiers of seats,
some 200 feet in height. At the foot of the
cliff is a low arch, the mouth of a cave, from
this cave issues a clear stream, the infant
Aire. But this is not the original source of
the river: above the Cove, on the great limestone
plateau of Malham, is Malham Tarn, & from
this Tarn issues a stream, which flows some
half a mile above ground; then, makes its escape
through fissures in the rock, eats out a way for
itself through the bowels of the plateau, is increased
by other underground streams, & comes to
light again, as we have seen, at the foot of
Malham Cove.

Now we have an example of the history of
cave-making: flowing water sinks through
the fissures of the rock, then, partly by erosion,
partly by dissolution of the rock substance,
enlarges

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of the greatest and most thriving seats of industry in
the empire.

This great coal field reaches down into Nottingham
but an concern is with that part of it which lies
within Yorkshire. A strip of the Lower Coal Measures,
upon which stand Leeds, Bradford, Halifax,
Huddersfield, borders the Central mass of the
'Middle Coal Measures', whereon are Wakefield,
Barnsley, Sheppfield, Rotherham.

Perhaps the best known coals of the Lower Coal
Measures in Yorkshire are, the Better Red Coal
of Bradford, a bright coal, very free from sulphur,
used in working the Low Moor Ironstone.

The latter exists in layers, never more than
two feet in thickness, far above the Coal
seams, ^{Low Moor iron} & perhaps owes its celebrity for superior
longthness as much to the excellence of the
Better Red Coal employed in smelting & purifying
it - as to the qualities of the Ironstone. The
Keelson Red, near Leeds, is another valuable
bed, the seams having the unusual thickness
of six feet in some places.

Above the Middle Coal Measures, localised as being
less deeply buried than the lower measures,
perhaps the most valuable seam is the
Lilthstone coal, reaching from the southern
boundary of the country as far north as Cantthorne
above Barnsley. The seam has a thickness
of some four or half feet, though it is divided
into two beds by a layer of sand. clay, a
few inches thick. This is excellent household
coal, & a great deal of it is sent to London.
This is succeeded to the north by the Blacking
Coal,

Coal, a seam at about the same level ^{to} the Silurian
but of poorer quality, which reaches northward nearly
to Leeds. At a much higher level is the celebrated
Barnley Bed, the most prolific in Yorkshire.
A seam more or less feet in thickness in its
neighbourhood of Barnley, & but thinning
out beyond Cheppiel to some four or five feet.
A ^{thin} ~~soft~~ soft-top & bottom layers make
good household coal, while the thinner, closer
centred portions supply steam-making coal.

We come now to the question, under what conditions were these coal beds laid down - the deeply bed foundation of the prosperity of the West - riding? We must carry our imagination back to a period which we can only describe as many millions of years ago. So many changes have taken place in the interval, that, even the coal measures in ~~position~~ ^{situ}, they would lie at a depth of fifty - thousand feet, that is, they would be utterly unperforated out - of - reach. But - throughout the long geologic 'periods' such have elapsed since the laying down of the coal, the crust of the earth has been ~~seen~~ ^{seen} undergone many plutonic upheavals. Causing cracks or 'faults' in the solid strata above. & thus the coal has been brought, just to the surface, at any rate within measurable & workable distances.

This black rock is basaltic in origin; it is the only rock of igneous origin which forms any considerable part of the earth's crust. This is, roughly, its history:— We have seen that that area including the centre of the British Isles which we have spoken of as occupied by an inland sea, was subject to alternate eras of elevation

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as dry land, submergence as the last of a
sea or lake; that is to say, the sandy bottom was
probably always either rising very very gradually,
or sinking or gradually; when it had risen
above the water level it was dry land, when
it had sunk below that level, it was the bottom
of a sea, each such change was the work of ages.
Now, during each of these periods of elevation, miles
of soil upon the sandy bottoms, & forests grew
upon them. Not such forests as grow in the
same latitudes now: the conditions were different.
The climate & soil were perhaps not unlike
those of the swamps which fringe the southern
states of ~~North America~~ bordering on the Gulf
of Mexico. An equable temperature, humid
soil, atmosphere which soil favored a
rank, tropical vegetation, of the nature of our
clubmosses & forest-trees for the most part
but developed into forest trees some sixty-
feet high - Sepidodendron, Sigillaria
& Calamites, together with tree-ferns, &
thick underwood of lesser ferns, & soft
of pines on the higher levels. Now these forests
decayed, very slowly submerged, were
compressed ^{by} ~~under~~ the earliest of hydrostatic
pressures, the weight of the sea above them;
now these forests were overlaid by a new
sandy sea-bottom, which went through the
same history of gradual elevation, by green jets
now ever increasing thickness, then, presiding
then, submergence, as the last. Now this was
repeated again & again, now after, we have some
no means of judging, not, fully a hundred
different seams of coal, each divided by the
under

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under. clay, which held, & still holds the roots of the forest
have been laid here in the South Wales coal field. But
is to say, there, a hundred times within human reckoning
has the land risen, borne forests, & been again
submerged. We cannot follow the workings, the
chemical changes which took place in these buried
forests - the heaving & throwing black which took place
in the moist mass, its change into a pulpy
condition wherein distinction vegetable forms,
leaves, fruit, &c., was almost entirely lost,
& lastly, its change into the hard, solid, semi-crystalline
~~substance~~ ^{substance} we are familiar with. We cannot enter
into the details which show the conditions which
obtained during the formation of this is that
particular bed, which account for the
differences in quality between coal & coal: but
enough has been said to account for the
several strata of the coal measures, - now,
the grit or sandstone of the old sea. Below, now,
shale, the soil of rivers, mud laid upon the
elevated sandbanks, wherein the forest grew, then
coal; then sandstone again, & so on. Now
too, we have the reason why our coal bed should
underlie another, & why, again, geologists should
find it convenient to divide these underlying coal beds into three
series - lower, middle, & upper.

Since the laying down of the Carboniferous strata
nine successive periods of formations have
occurred, & of these ^{as the upper rock} ~~five~~ appear in Yorkshire
in the curiously consecutive order we have
noticed - the Permian strata, Lias, Liassic,
Triassic, ^{besides numerous deposits,} ~~the~~ ^{appears as the}
Jolite, Cretaceous, & so on. To say nothing of the glacial drift which
fills the vale of Pickering.

it is worth while to consider the character of this limestone stratum.

The Swale, Ure, & Wharfe, Aire & Ribbles have all cut ^{many} of their upper valleys out of the solid limestone, & their upper courses give opportunity to study the characteristics of limestone country. Upper Wharfedale, ~~between~~ ^{from above} Burnsall to Deepdale, is, perhaps, the most beautiful & the most characteristic of these valleys. Like the Tees, the Wharfe is -

"Condemned to mine a channel & way
O'er solid sheets of marble grey," -

& the clear brown waters, brown from the pebbles where they rise, course through a clean swept channel, ^{of} grey slabs. Every now & then, enormous boulders break the current, slowing the waters into pools; where, the pale hue of the rock is set off by draperies of the richest-darkest mosses. Alders hang over the stream, a little higher, are hazel thickets, with birch & rowan for variety; & in the thickets of the limestone hills above, the cold grey green of the ash is the prevailing tint. A special feature of this limestone country is the lovely lawn-like meadow & pastures which fill the lower valley; lawn-like, that is, after the first & second cutting of the hay, but lovely always, for it is the property of the limestone, whereas a close, short, vividly green turf, greener & brighter than the delicious turf of the chalk, though less pure & elastic. The flowers are very abundant & lovely; the handsome purple willow ^{per}

Geraniums, meadow saxifrage, rock cistus,
 several species of orchid, the yellow pansy, &
 many more - so many to name. The great
 beauty & variety of the moss which is
 another feature of the limestone country, which
 he designed to accustom to the pale rock; while the
 low top of many a fell offers a paradise to the fern-
 collector. I know of one such fell, but will not tell
 its whereabouts, where the hill top is paved with
 limestone ^{slabs} ~~flags~~ like enormous ^{flat} gravestones;
 in the crevices, a foot or so in width, between
 these slabs, are ~~scattered~~ ^{hundreds} of rounded
 ferns, every plant perfect & delicate in
 hue as if preserved under glass. Now you find
 the limestone Polypody, (Polypodium Robertianum),
 the Green spleenwort, (Myriophyllum Viscid.), the
 black maiden-hair spleenwort, (A. Adiantum-
nigrum), the Seal fern, (Ceterach Officinatum),
 the common Hart's tongue, (Scelopendrium
Vulgare), very abundant & beautiful, in fact, all
 the ferns peculiar to the limestone.
 Now, on this hill, & indeed on all the hills, on
 the beds of the rivers & scattered freely throughout
 Craven, are oddly shaped masses, like huge, bleached
 weather-worn trunks of trees that had lain on the
 ground for centuries. Much like vegetable
 or animal remains as they look, these are
 limestone boulders, worn into these fantastic
 shapes by the action of water. Indeed, all the peculiar
 & very picturesque rock scenery of Craven is due
 to the extraordinary effect that moisture has upon
 limestone rocks.

The great thickness of limestone which overlies
 this part of Yorkshire is not to be thought of

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regions presenting very different landscapes
smackings very different geological conditions.
Now, following still the order of time, & beginning at
the North, we have, first, the North eastern Moorlands,
with vegetation not very unlike that of the
Western Moorlands, though supported on rocks
of far more recent origin.

Going south, we cross the Vale of Pickering.
Full of verdure & fertility, its
surface rock being the boulder clay of glacial
origin.

Next succeeds the chalk of the Wolds; & lastly
Holderness, consisting of recent deposits,

the debris of the rest of the country.
So intimately are the landscape, & through the
agricultural & manufacturing industries of
a district connected with its geological formation
that Yorkshire may be roughly parcelled out into
some six or seven series of landscapes
corresponding with the geological structural divisions
we have indicated.

The Silurian rocks, infinitely the oldest series
which Yorkshire exhibits, appears only in one
or two places. You are surprised to come
upon quarries of bluish-green slates in
the neighbourhood of Ingleton, & again, to
the north of Sedburgh, the same hard rocks
appear. How far the Silurian rocks underlie
the limestone we need not inquire here;

but the landscape & industries of Western
Yorkshire depend so largely on the Carboniferous
Series, that we must give a more detailed account
of these.

In remote geologic time, a landlocked sea
occupied the centre of the space now occupied by
the

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The British Isles - a sea with many shells, fish, corals, graminifera, multitudinous marine animals which produced their shells or harder parts of the carbonates of lime which the rivers falling into this sea constantly brought down in solution. As countless generations of these marine creatures died, the hard part of their bodies secreted fell to the bed of the sea. In the course of ages, this perpetually increasing deposit of limestone nearly choked the sea, & now, in the Craven district, this accumulation of the ~~remains~~^{remains} of marine animals reaches a thickness of 500 or 600 feet; while in Derbyshire, which was also included in the bottom of this ancient sea, a depth of 1000 feet has been measured. Here we have the origin of the Mountain, a Carboniferous limestone which forms a district of singular beauty & peculiar character in the north-west of the County. You may often see that the limestone is simply a mass of shells, corals, encrinurans, &c. but more commonly, these shells are so broken or so small that the combined mass looks like a ^{compact} whitey-grey stone rock. The gradual elevation & hardening into dry land of this sea-bottom is a process we can conceive of. But, how is it that this enormously thick solid floor of limestone we have spoken of should not be co-extensive with the ancient sea where it was laid, should not, ^{in probability, for instance,} ~~extend far~~ ^{cover the area of the County?} ~~to the south-east~~ instead of being confined to the north-west? It does extend in this manner, but, in the south-east, it is buried under an enormous depth of more recent deposits. How these deposits were laid, we may consider later, but, in the meantime,